

Modelling the determinants of supply chain management to improve organisation performance: Study of Indian Cement Industry

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Abstract

In cement industry, companies are selling product that is high density and low value to weight ratio and focusing on economies of scale to earn more profit. In cement industry the competition is not among companies but between the supply chains and because of this supply chain management has become the effective way to achieve competitive advantage and improve organisation performance. This study is conducted to analyse the factors that are responsible for strong relation between SC management practices, Supply chain performance, competitive advantage and organisation performance. In this study, to understand the relationship 6 dimensions of supply chain management practices, 5 dimensions of supply chain performance, 5 dimensions of competitive advantage and 4 dimensions of organisation performance was identified and empirically tested. Data for the study was collect from SC professionals and employees from cement industry with this assumption that they are aware about the supply chain concept. Collected data was digitized and analysed using SmartPLS.

Key Words: Cement industry, Supply chain management, Supply chain performance, Competitive advantage, Organizational performance, Structural equation modelling

1. Introduction

Supply Chain Management (SCM) is a critical aspect of the Indian cement industry, which plays a pivotal role in the country's infrastructure development and construction sector. SCM involves the planning, coordination, and optimization of various activities, from raw material procurement to product delivery, in order to ensure the efficient flow of goods and services within the industry. In the case of the Indian cement industry, SCM is particularly important due to its complex network of operations and the need to manage resources effectively to meet the growing demand for cement.

Historical Perspective: The Indian cement industry has come a long way since its inception in the early 20th century. It has evolved from a handful of manufacturers to a highly competitive

sector with numerous players. This transformation has necessitated the development of sophisticated supply chain strategies to ensure the timely availability of raw materials, efficient production processes, and reliable distribution networks.

Key Components of Supply Chain Management in the Indian Cement Industry:

Raw Material Procurement: One of the critical components of SCM in the cement industry is the procurement of raw materials, primarily limestone, clay, and gypsum. Cement companies need to secure a consistent supply of high-quality raw materials to maintain production efficiency.

Production Process: The manufacturing process in the cement industry involves the precise blending of raw materials, clinker production, and grinding to produce the final cement product.

Managing this process efficiently is crucial to maintaining product quality and minimizing wastage.

Logistics and Transportation: Cement is a bulky and heavy product, which makes logistics and transportation a significant aspect of SCM. Companies need to ensure that their products reach construction sites and retailers on time and in the required quantities. This involves managing a fleet of trucks, railways, and sometimes even waterways for long-distance transportation.

Inventory Management: Cement is a perishable product, and managing inventory levels is essential to avoid overstocking or under stocking. Effective inventory management helps in cost control and ensures that products are readily available when needed.

Distribution and Retail: Cement companies need to establish an efficient distribution network to reach the vast construction market in India. This includes setting up regional warehouses, partnering with distributors, and managing relationships with retailers.

Demand Forecasting: Accurate demand forecasting is crucial in the cement industry, as it helps companies plan their production schedules, allocate resources efficiently, and avoid shortages or excess production.

Technology Integration: In recent years, technology has played an increasingly significant role in SCM. Cement companies are adopting advanced technologies such as ERP (Enterprise Resource Planning) systems, IoT (Internet of Things) sensors, and data analytics to optimize their supply chain operations.

Despite its growth, the Indian cement industry faces several challenges in SCM, including regulatory hurdles, environmental concerns, and the need for sustainable practices. Future trends in SCM for the Indian cement industry may include increased use of alternative raw materials, adoption of eco-friendly production techniques, and further integration of digital technologies to enhance efficiency and sustainability. Supply chain management is a critical aspect of the Indian cement industry, playing a vital role in ensuring the timely and efficient production and distribution of cement products. The industry's evolution and growth have led to the development of sophisticated supply chain strategies, which

continue to evolve to meet the changing demands of the construction sector in India.

Supply chain management (SCM) is a term that was first introduced by consultants in the early 1980's and has since then frequently gained increased attention by both researchers and organisations (Lambert & Cooper, 2000). Today, it has become one of the most discussed topics in business literature (Peng Wong & Yew Wong, 2007) and is considered a key strategic element (Gunasekaran et al., 2001). The reason for the increased focus in supply chain management is largely due to the complex environment in which companies compete. Markets have become far more dynamic and turbulent with rapid changes in customer requirements (Jespersen & Skjott-Larsen, 2005). The markets have also become more segmented which means that customers have various requirements for products and services. In addition, increased requirements on companies from a market to deliver multiple product varieties and provide customised solutions of both products and services are increasing. Furthermore, global competition has put pressure on companies to become faster, better, and cheaper (Jespersen & Skjott-Larsen, 2005). This implies that companies have begun to use outsourcing as a main strategy since it is costly and difficult to produce the needs solely on their own (Gunasekaran et al., 2001). In turn, this emphasise the importance for companies to build strong relationships with other actors in the chain in order to stay competitive. The increased importance for cooperation and integration among actors results in greater complexity when it comes to management and control of technology (Jespersen & Skjott-Larsen, 2005). Companies and managers have started to realise the potential benefits with supply chain management, and also that competition now increasingly exists between different supply chains rather than between two companies. In spite of companies' and managers' recognition of supply chain management they often lack the ability to develop effective performance measures and metrics (Gunasekaran et al., 2001). This is supported by Bourne et al. (2003) who state that approximately 70 percent of the attempts to implement performance measurement systems (PMS) fail. Measuring supply chain performance might lead to a greater understanding of the supply chain and helps to test and reveal the viability of a firm's strategies. In addition, Ramaa et al. (2009) state that measuring supply chain performance provides

important feedback information, helps to reveal progress, increase employers' motivation and communication, and helps to diagnose problems. The measures that help a company measure their progress on performance objectives in everyday work are often referred to as key performance indicators (KPIs). In general, an extensive amount of research literature has been addressing the subject of PMSs including descriptions of how they are to be developed as well as highlighting their

importance. However, (Chan & Qi, 2003) state that even though plenty of models have been developed for PMSs and that an extensive amount has been written about them, there are still relatively little literature covering PMSs and the selection for performance measures in the context of SCM. Some authors have treated the subject but there is still a need to explore and investigate this orientation further.

2. Research Framework

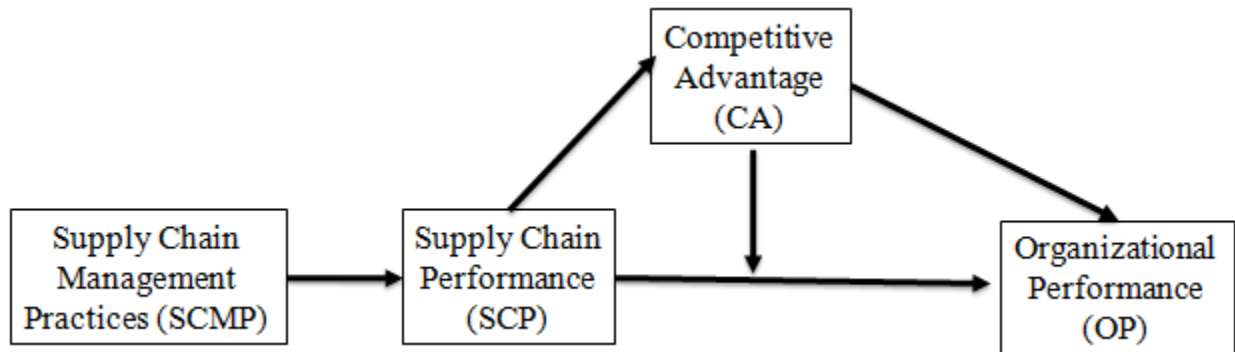


Fig 1: Research Framework

Fig 1, present the research framework developed for this research. This framework proposes impact of Supply Chain Management Practices (SCMP) on Organisation Performance (OP) both directly and indirectly via Supply chain performance (SCP) and Competitive Advantage (CA).

3. Research Hypothesis

The four dimensions mentioned in the research framework were developed after extensive literature survey and panel discussion with academicians and supply chain practitioners. The research hypotheses were developed to understand the relationship of all four construct Supply chain management practices, Supply chain performance, Competitive advantage and organizational Performance.

H1: The higher level of SC management practices (SCMP) results into higher level of Supply chain performance (SCP).

H2: Organizations having high level of SC management performance (SCP) will have high level of Competitive advantage (CA).

H3: Organizations having high level of Competitive advantage (CA) will have high level of organizational performance (OP).

H4: The higher level of SC performance (SCP) results into higher level of organizational performance (OP).

4. Research methodology

To understand the relationship between SCMP, SCP, CA and OP, we have conducted exploratory research. Total 31 items (**Table 1**) were selected with the help of extensive literature review. These items were categorized in the categories after the extensive discussion academicians and SC experts. To check the content validity, pilot survey was conducted and finally after the result of pilot survey ambiguous items were deleted and total 22 items were considered and as per the requirement of SmartPLS 4, 9-point scale was developed for the collection of data. For this study, Data was collected from SC professionals and employees from cement industry with this assumption that they are aware about the supply chain concept.

Table 1: Items for research		
SCM Practices	1. Organisation focus on relationships with suppliers in improving supplier responsiveness	SCMP1
	2. Organisation focus on Improved information flow between different stages of SC to improve accuracy, and credibility of information	SCMP2
	3. Organisation implement various managerial levers to improve coordination in SC	SCMP3
	4. In order to better serve the end customer, Organisation focus on developing strong SC network	SCMP4
	5. Organisation promote use of technology to improve overall SC efficiency	SCMP5
	6. Organization have environmental policy and programs	SCMP6
Supply Chain Performance	1. to improve the demand forecast and reduce lead times	SCP1
	2. to determine realistic supplier lead times	SCP2
	3. to better understand its demand patterns and improve its forecasting accuracy	SCP3
	4. improved productivity and customer satisfaction	SCP4
	5. improve material availability	SCP5
Competitive Advantage	1. Organization is capable of offering product quality and performance that creates higher value for customers	CA1
	2. Organization is capable of providing the type and volume of product required by customer, "on time"	CA2
	3. Organization is capable of introducing new products faster than major competitors	CA3
	4. Organisation is capable of reducing overall SC cost	CA4
	5. Organization is capable of competing against major competitors based on low price	CA5
Organisational Performance	1. Organisation engage stakeholders in SCM process to build strong relationship with them.	OP1
	2. Organisation perform various activities to improve customer satisfaction and engagement	OP2
	3. Organisation is performing better than the competitors in market	OP3
	4. Organisation is capable of fulfilling the demand of the product in the market	OP4
	5. Organisation follow the policies described by the government bodies which demand more transparency to cover the benefits of stakeholders	OP5
	6. Environmental sustainability is the priority of the Organisation	OP6

To test the hypothesis developed, the data was collected from cement companies having their offices in different part of country with the help of questionnaires using convenience and Judgmental sampling methodology (offline and online mode) for all 22 items. Total 750 respondents were contacted in span of 10 months starting from Jan 2022 to Oct 2022, for data collection, out which 108 questionnaire were rejected due to misleading response as observed. Finally, 642

questionnaires was used for analysis purpose. This sample also justifies the basic requirement of PLS-SEM, in which sample size must be 10 times the number of items in the model. (Hair et al,2014). The questioner was prepared in English and scheduled technique was used to collect the data. Questionnaire was in two parts where in first part basic demographic information was taken from the respondents and in second part items measured SCMP, SCP, CA and OP 9-point scale

with 1 as “strongly disagree” and 10 as “strongly agree”.

5. Data analysis and results

5.1 Common Method Bias

To understand the common method biasness in the data, we used Harman’s single factor test and this test explained 57% of total variance, which is off course not below 50% but we have ignored this because this normally happen in behavioral research. (Fuller, Simmering, Atinc, Babib, 2016)

5.2 Exploratory Factor Analysis

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.957	.960	22

To understand the underlying relationship among variables we have conducted exploratory factor analysis to understand the dimension of factors taken for research and result revealed that measures KMO and Cronbach alpha are having 0.851 and 0957 respectively, which is near to one. Factor loading (Table 2) also having values greater than 0.7 that represent sufficient variance from the construct.

Items	Values			
	SCMP	SCP	CA	OP
R Square		0.831	0.827	0.771
R Square Adjusted		0.811	0.826	0.766
Cronbach's Alpha	0.835	0.862	0.901	0.905
Composite Reliability	0.856	0.875	0.912	0.912
Average Variance Extracted (AVE)	0.550	0.645	0.772	0.680

	Items	Factor Loading		Items	Factor Loading
Supply Chain Management Practices	SCMP1	0.651	Competitive Advantage	CA1	0.889
	SCMP2	0.779		CA2	0.901
	SCMP3	0.609		CA3	0.919
	SCMP4	0.871		CA4	0.801
	SCMP5	0.674		CA5	0.722
	SCMP6	0.830			
Supply Chain Performance	SCP1	0.778	Organisational Performance	OP1	0.836
	SCP2	0.780		OP2	0.797
	SCP3	0.848		OP3	0.873
	SCP4	0.732		OP4	0.847
	SCP5	0.871		OP5	0.871
				OP6	0.712

The reliability and validity of reflective measurement model was tested with the help of R square, Cronbach’s Alpha, Compositive reliability and AVE (Table 3). To check the indicator reliability, the factor loading values are examined and found perfect as all the values of SCMP, SCP, CA, OP is greater than 0.6. R square, Cronbach’s Alpha, Composite reliability and AVE, all are having values higher values than recommended value of 0.7, 0.7, 0.7 and 0.5 respectively, which verify and validate convergent

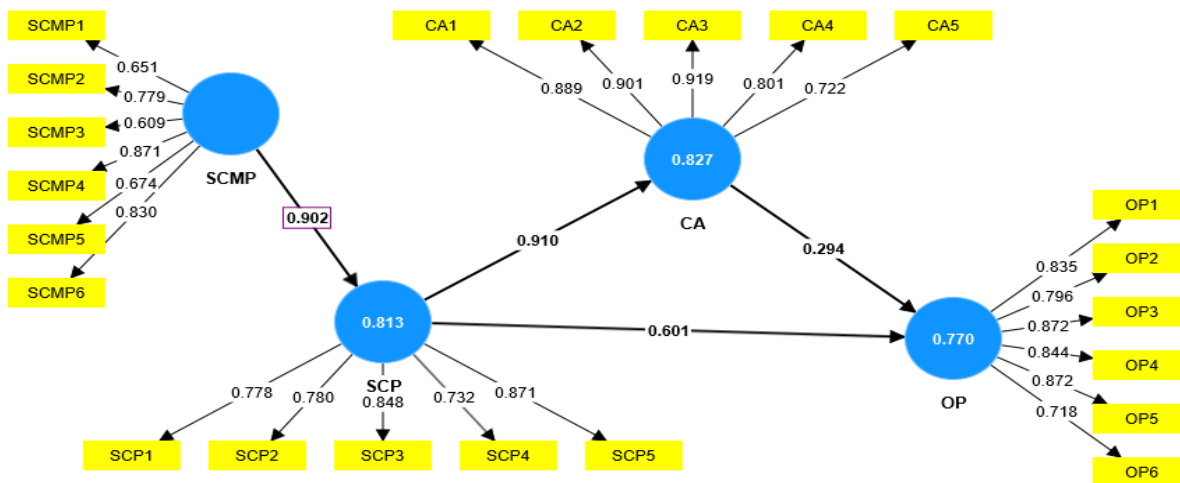
Items	Value
SCMP -> SCP	0.701
SCP -> CA	0.960
CA -> OP	0.792
SCMP -> CA	0.749

validity. To test the Discriminant validity (Table 5), HTMT values are calculated. All are having below 0.9 except one (SCP->CA).

Table 6: Total Indirect Effects

SCM Practices -> Competitive Advantage -> Organisational Performance		
Original sample (O)	T statistics (O/STDEV)	P values
0.542	4.156	0.000
SCM Practices -> Supply Chain Performance -> Competitive Advantage		
Original sample (O)	T statistics (O/STDEV)	P values
0.820	19.888	0.000
Supply Chain Performance -> Competitive Advantage -> Organisational Performance		
Original sample (O)	T statistics (O/STDEV)	P values
0.268	2.060	0.000
SCM Practices -> Supply Chain Performance -> Competitive Advantage -> Organisational Performance		
Original sample (O)	T statistics (O/STDEV)	P values
0.241	20.42	0.000

5.3 Structural Model



In this step the hypothesis was tested to understand the significance of relationship. To test the direct relationship, basic bootstrapping was done with 10000 resample at 95% confidence interval using two-tail percentile bootstrap confidence Interval method. The result is shown in Table 7. The result shows that all the three hypotheses (H1 to H4) are significant and accepted.

In **H1**: supply chain management practices ->supply chain performance, the positive value ($\beta = 0.902$) shows that the relationship between supply chain management practices and supply

chain performance is positive and significant and indicate that proper implementation of supply

Table 7: Direct Relationship- Hypothesis from H1 to H3

	β	T	P
H1 :SCMP ->SCP	0.902	10.814	0.000
H2 : SCP -> CA	0.910	13.085	0.000
H3 :CA -> OP	0.294	2.950	0.000
H4 : SCP -> OP	0.601	4.866	0.000

chain management practices will improve supply chain performance.

In **H2**: SCP->CA ($\beta = 0.910$) also indicates that SCP is positively related with CA and increase in level of SCP will pose positive impact on CA. This is also evident from the data that the supply chain performance will pose positive impact on CA means help organisation to maintain the position in today's competitive world.

In Hypothesis **H3**: CA ->OP ($\beta = 0.294$) also having positive and significant relationship. This is also evident from the data that that the relationship between Competitive Advantage and Organisational Performance is positive and significant and when Competitive Advantage will increase the level of Organisational Performance will go up. The increased competitiveness of a firm may enable a firm to outperform and keep the better position in today's dynamic business world.

In Hypothesis **H4**: SCP ->OP ($\beta = 0.601$) also having positive and significant relationship. This is also evident from the data that SCMP is positively related with CA and increase in level of SCMP will pose positive impact on CA. This is also evident from the data that the supply chain practices will pose positive impact on CA means help organisation to maintain the position in today's competitive world.

6. Discussion and conclusion

With the help of this study, it was observed and identified that the Organisation Performance largely depend on Supply chain management practices, supply chain performance and Competitive advantage. It was also identified that some of the SC management practice constructs like coordination, Information flow, SC network, supplier relationship, that play vital role in improving overall supply chain performance. Practitioners also perceives that the SC practices play vital role in improving overall supply chain performance of the organisation that finally contribute in organisation Performance. They also indicated that SC network and relationship with supplier is the vital indicator of SC performance.

It was also identified that providing value to the customer, new product introduction and timely delivery of the product helps in achieving higher competitive advantages in cement industry. It was also identified that the reduction of Total Cost and Time to market the product in cement

the market will play a key role in gaining more competitive advantage over competitors.

This study finding shows that the organisation focusing on SC performance, must work on measures to improve supply chain practices factors especially relationship with suppliers, flawless information flow between stakeholders, high degree of coordination, SC network and technology implementation to improve overall performance. This research employs the interview and questionnaire technique to collect the data for analysis and interpretation on selected factors through literature review. It is recommended that in future, the same model can be tested on another group of executives from same area for the purpose of statistics generalization.

There is also scope for research to be done on industries like consumer or automobile companies. Comparison can then be made between the various industries to understand if critical success factors are similar or different across industries and countries. Such learning can help various industries develop supply chain strategies that lead to Competitive Edge and business success.

Although, the concept of SCM is complex and involves many factors to justify the relationship, I tried my best to integrate all the existing features to justify the relationship between the four parties and conducted empirical study to draw the conclusion.

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